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AUTHOR Martin, Jack
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ABSTRACT

The allophonic variation in the quality of the resonant consonants of two Missouri River (Siouan) languages, Crow and Hidatsa, has not previously been studied adequately. Evidence is provided in this paper that /m/ and /n/ are the best representations for the underlying resonants in Hidatsa as well as Crow and Proto-Missouri River. Establishing the correct phonemic analysis of these sounds is important not only for the synchronic description of them, but also for reconstruction of the history of the sounds in Proto-Siouan. A phonemic analysis of resonants in Crow and Hidatsa is presented, followed by a discussion of the implications of the synchronic analyses for Proto-Missouri River. Contains 14 references. (LB)

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UNDERLYING NASALS IN CROW, HIDATSA AND PROTO-MISSOURI RIVER (SIOUAN)

Jack Martin

1. The two Missouri River (Siouan) languages Crow and Hidatsa have allophonic variation in the quality of their resonant consonants that has received inadequate attention in previous studies.[1] Harris and Voegelin (1939) (and subsequently, Robinett (1955) and Matthews (1965)) adopt an analysis of Hidatsa in which the phonemes /w/ and /r/ are used to represent the sounds [b,m,w] and [d,n,r]. Their analysis is subsequently extended to describe similar allophonic variation in Crow by Kaschube (1967). Gordon's (1972) description of pitch accent in Crow differs in writing /m/ and /n/ for the underlying phonemes, but does not provide arguments for the shift in analysis. Here I provide evidence that /m/ and /n/ are the best representations for the underlying resonants in Hidatsa, Crow, and Proto-Missouri River. Establishing the correct phonemic analysis of these sounds is important not only for the synchronic description of these languages, but for reconstruction of the history of these sounds in Proto-Siouan. Sections 2 and 3 deal with the phonemic analysis of resonants in Crow and Hidatsa, respectively. Section 4 concludes with a discussion of the implications of the synchronic analyses for Proto-Missouri River.

2. Crow. Modern Crow has two sets of alternations, [b,m,w] and [d,n,l], exemplified by the following forms:[2]

(1) a. *báa-waši-k* 'I hired (someone)'
dáa-waši-k 'you hired (someone)'
báaši-k 'he/she hired (someone)'

b. *šipít-baa-k* 'I blackened it'
šipít-daa-k 'you blackened it'

c. *día-waa-k* 'I did it'
día-laa-k 'you did it'
día-k 'he/she did it'

d. *koóm-maa-k* 'I quit it'
koóm-naa-k 'you quit it'
koowée-k 'he/she quit it'

e. *dakáaka-m* 'a bird'

f. *dišší-w-ihma* 'I will dance'[3]

Restricting our attention to the verb paradigms in (1a-d), we observe that there are three forms (*baa, waa, maa*) for the first person marker and three parallel forms (*daa, laa, ɲaa*) for the second person marker. From these preliminary data, it appears that oral stops occur initially and after oral consonants, that continuants occur intervocalically, and that nasals occur next to nasals. These alternations are wide-spread in the language, and are not limited to agreement markers. The forms in (1e-f) show that nasals also occur finally and after /h/.

Although modern speakers use [l] intervocalically, older sources (e.g. Lowie 1941) record a flapped [r] (see Kaschube 1967 and below for further discussion). Kaschube (1967) adopts /r/ as the phoneme underlying the [d,n,l] alternations in (1), describing the distribution of the [n] and [d] allophones of /r/ in the following terms (p. 8):

A dental nasal allophone [n] occurs in word initial position when followed by a vowel.

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> It occurs in word final position when preceded by a vowel. It occurs in medial position when preceded by the phonemes /w-/ and /h-/, and occurs in intervocalically situated geminates...A voiced dental stop [d] occurs in free variation with initially positioned [n], and I have transcribed both sounds for the same utterance...

Kaschube's distributional characterization of the [n] and [d] allophones of /r/ can be crudely translated into the following rules:

(2) a. /r/ —> $\left\{\begin{matrix}[n]\\[d]\end{matrix}\right\}$ / # __ V (with [n] and [d] in free variation)

b. /r/ —> [n] / V __ #

c. /r/ —> [n] / {w,h} __

d. /r/ —> [n] / r __

e. /r/ —> [n] / __ r

Kaschube does not mention the following generalizations:

f. /r/ —> [n] / __ w

g. /r/ —> [d] / C __ (where C is not /r,w,h/)

Rule (2f) is needed to account for forms such as *bim-muúss-dee-k* 'he went into the water' in which the underlying /r/ of /wiri/ 'water' is nasalized before a /w/ and then assimilates in place to the following consonant. Rule (2g) is needed to describe the occurrence of [d] in the same word, and in *šipít-daa-k* 'you blackened it' (1b).

There are several minor problems with these rules as stated. First, it is unnecessary to mention 'V' in the environment of (2a) and (2b), since initial and final consonant clusters do not arise in the data. Second, when the sixth rule (2f) is added, we see that /r/ nasalizes in Crow whenever it occurs adjacent to /r/ or /w/. This new fact suggests that the portion in (2c) referring to /w/ and the portion referring to /h/ should be separated, and that rules (2d,e,f) might better be collapsed as a mirror-image rule with the portion in (2c) referring to /w/. Adopting these suggestions, the rules in (2) would be replaced by the rules in (3):

(3) a. /r/ —> $\left\{\begin{matrix}[n]\\[d]\end{matrix}\right\}$ / # __ (with [n] and [d] in free variation)

b. /r/ —> [n] / __ #

c. /r/ —> [n] / $\left\{\begin{matrix}r\\w\end{matrix}\right\}$ __ % (where '%' indicates a mirror-image rule)

d. /r/ —> [n] / h __

e. /r/ —> [d] / C __ (where C is not /r,w,h/)

The rules in (3), while an improvement on the rules in (2), are still suspiciously complex.

Rule (3c), for instance, seems particularly odd: What phonetic motivation would there be

for sequences of the shape /rr/, /rw/, and /wr/ to nasalize as [nn], [nm], and [mn], respectively, and for /r/ to nasalize after /h/ and word-finally? Ordinarily one expects that geminates will be more resistant to phonological processes than nongeminates; Kaschube's phonemic solution requires that geminate /rr/ undergo nasalization intervocalically, while nongeminate /r/ remains oral. Further, she has chosen the allophones with the most restricted distribution as the underlying phonemes.

Rule (3e) is equally suspect. Even granting the possibility that /r/ might harden to [d], neither the class of consonants triggering hardening nor the class of exceptions to hardening generalize well as a natural class. An alternative account that appealed to natural classes of sounds would thus be preferable.

In fact, if /n/ and /m/ are chosen instead of /r/ and /w/ as the phonemes underlying these alternations in Crow, the rules in (3) can be made simpler and more natural. Ignoring (3a) (which differs from the other rules in its optionality) rules (3b-e) can be reduced on this alternative account to the rule in (4):

(4) **Oralization**:
[+nasal] —> [-nasal] / [-nasal,+consonantal] __

Rule (4) oralizes /n/ after oral consonants, except when the preceding segment is /h/.

There are several arguments for replacing (3b-e) with (4). First, (4) is simpler than (3b-e). (4) consists of a single statement, while four statements are necessary in (3b-e). Second, (4) is a phonetically motivated process of assimilation, while there is no obvious motivation for /r/ nasalizing in clusters with /r/ and /w/. Third, the solution in (4) eliminates the unusual condition in (3e). It remains to be seen whether this solution will extend to other allophones, however.

Kaschube goes on to describe the distribution of the [r] allophone of her phoneme /r/:

> A third allophone, [r] occurs only in intervocalic position and sometimes has a flap-like quality which corresponds closely to *d*...

Kaschube mentions that her female speaker uses [l] intervocalically, while her male speakers use [r]. The Crow speakers I have consulted (one male and one female) both use [l], and do not recognize [r], except as an odd spelling in words like *Apsaroke* (a place name now pronounced *apsáalooke* 'Crow'). Because Kaschube adopts /r/ as the underlying phoneme, she need not posit a rule to account for the intervocalic allophone. With /n/ as the underlying phoneme, the following rule will need to be added to (4):

(5) **Crow Lenition**:
[+nasal] —> [+continuant] / V__V

Rule (5) changes /n/ to [l] intervocalically. Rule (5) should probably not be collapsed with rule (4), since the environments are different.

The [b,m,w] alternation exemplified in (1) can be described with the existing rules. The distribution of [m] is virtually identical to the distribution of [n]:

> A bilabial nasal allophone [m] occurs in word-initial position when followed by a vowel, and in word final position when preceded by a vowel. It also occurs in medial position when followed by phoneme /r/; when preceded by phoneme /r/; when preceded by /h/,

and in geminates in intervocalic position. (Kaschube, p. 8)

One should add that [b] also occurs phrase-initially, and that [b] occurs after consonants other than /w/, /r/, and /h/.

As with the alveolar resonant, choice of /m/ as the underlying phoneme instead of /w/ will simplify the rules needed to describe Crow and make those rules more natural. However, the optional rule (3a) needs to be reformulated taking /m/ and /n/ as basic:

(6) **Initial Oralization:**
[+nasal] —> [-nasal] / ##__

Rule (6) oralizes /m/ and /n/ to [b] and [d] phrase initially. For Kaschube's speakers, this rule was optional. My consultants allow some variation, but seem to prefer the oral stops except when the preceding word ends in a nasal. I have therefore made reference to a phrase boundary (##) in (6) rather than to a simple word boundary.

The three rules in (4), (5), and (6) can now derive the same data accounted for by Kaschube's more complex distributional generalizations. Consider, for example, the following derivation involving the word /mini/ 'water':

(7)	/mini+k/	'water'+SENTENCE FINAL
	/mili+k/	(Oralization (4), Crow Lenition (5))
	/bili+k/	(Initial Oralization (6))
	bilík	'it's water'

In (7), the two rules of oralization and the rule of Lenition operate to give the correct form. When the word for 'water' has a vowel preceding it, we see lenition of the consonant, as in the following derivation:

(8)	/mahaa+mini+k/	'spring'+'water'+SENTENCE FINAL
	/mahaa+wili+k/	(Oralization (4), Crow Lenition (5))
	/bahaa+wili+k/	(Initial Oralization (6))
	bahaawilík	'it's spring water'

When preceded by an oral consonant other than /h/, however, /m/ appears as [b]:

(9)	/muluxi+mili+k/	'ice'+'water'+SENTENCE FINAL
	/mulux+mini+k/	(Vowel Deletion)[4]
	/mulux+bili+k/	(Oralization (4), Crow Lenition (6))
	/bulux+bili+k/	(Initial Oralization (7))
	bulúxbilik	'it's ice water'

Finally, when a nasal consonant is adjacent, oralization is blocked:

(10) /ana+mini+nee+hk+uu+k/ LOC+'water'+'go'+CAUS+NOM+SENTENCE FINAL

/an+min+nee+hk+uu+k/ (Vowel Deletion)

/am+min+nee+hk+uu+k/ (Assimilation)[5]

amminneéhkuuk 'it's a ditch'

The derivation of forms involving 'water' in (7-10) thus demonstrates how the rules in (4), (5), and (6) operate naturally to create multiple surface forms if /m/ and /n/ are adopted as phonemes in Crow.

An alternative interpretation of these facts would be to adopt a particular theory of underspecification, and to use the feature [±sonorant] where I have used [±nasal]. The rules in (4), (5) and (6) above would then be restated as follows:

(11) **Desonorization:**
[+sonorant] —> [-sonorant] / [-sonorant, +consonantal] __

(12) **Crow Lenition:** (alternative approach)
[+sonorant] —> [+continuant] / V__V

(13) **Initial Desonorization:**
[+sonorant] —> [-sonorant] / ## __

The following redundancy rule would then apply to nasalize all [-continuant] sonorants:

(14) [+sonorant, -continuant] —> [+nasal]

Such a system would describe the same data, but would do so without giving distinctive status to the feature [±nasal].

I have no objection to this approach, or to the rules in (11-14). I do maintain, however, that the labels /m/ and /n/ are more appropriate for the bundles of distinctive features needed for the Crow resonants than are /w/ and /l/ (or /r/). Specifically, I assume that the sounds [m], [w], [n], [l], [b], and [d] are distinguished as follows:

(15)

	b	*m*	*w*	*d*	*n*	*l*
sonorant	-	+	+	-	+	+
continuant	-	-	+	-	-	+
coronal	-	-	-	+	+	+

The classification of [m,w,n,l] as sonorants, and of [w] as a continuant, is taken from Stevens and Keyser (1989). The classification of [l] as a continuant is based on Chomsky and Halle (1968). This particular assignment of features is useful, as we have seen that [w] and [l] pattern together distributionally in Crow.

Presented in this light (and thus ignoring the feature [±nasal]), we see that [m,n] are distinguished from [w,l] by the feature [±continuant]. Whether to use /m/ and /n/ or else /w/ and /l/ as the cover symbols for the underlying sonorants in Crow then reduces to the following question: Are these segments underlyingly [+continuant] (i.e., more like /w/ and /l/) or are they

underlyingly [-continuant] (i.e., more like /m/ and /n/)?

It should be clear from the data in (1) that the [+continuant] allophones in Crow are the most restricted distributionally. Allophones [w] and [l] only occur between vowels, while the noncontinuants [m] and [n] occur in a wider variety of environments. It will therefore be simpler to assume that the sonorants are *not* [+continuant] underlyingly, and therefore that they become [+continuant] by rule (5) or (12). If the underlying resonants in Crow differ from surface [w] and [l] in not being [+continuant], and if, as assumed on this alternative view, they are distinguished from other consonants by the feature [+sonorant] rather than by the feature [+nasal], then one is still left with the conclusion that the feature values of the underlying sonorants in Crow are more like those of /m/ and /n/ than like those of /w/ and /l/.

3. Hidatsa. In their 1939 analysis of Hidatsa phonemes, Harris and Voegelin describe allophonic variation in Hidatsa resonants as follows (p. 183):

(16) a. /w/ and /r/ are limited to syllabic initial position.

b. /w/ and /r/ are phonetically [m] and [n] in word initial position.

c. /w/ and /r/ are realized as [w] and [r] intervocalically.

d. before /i/, /w/ is occasionally realized as a bilabial fricative, and /r/ is pronounced as one flap "with glottal attack or momentarily held".

Because I lack clear data, I will ignore here and below the bilabial fricative and flap allophones in (16d). The following data from Robinett (1955) provide evidence against (16a):

(17) a. karáwi-c 'he remembers'
karáp 'remember!'

b. hiráwi-c 'he sleeps'
hiráp-he·-c 'he made him sleep'

(18) a. tá·ri-c 'he crosses'
tá·t 'cross!'

b. kí·ri-c 'he looks'
kí·t 'look!'

c. ká·ri-c 'he asks him for it'
ká·t 'ask him for it!'

She describes these new alternations as follows (p. 5):

> /w/ and /r/ followed by weak vowels...in the environments in which the vowels are absent...are replaced, respectively, by /p/ and /t/.

She thus follows Harris and Voegelin in assuming that /w/ and /r/ are the phonemes representing the sounds [m,w,p] and [n,r,t].

Matthews (1965:296) adopts the Harris and Voegelin phonemic analysis of Hidatsa, but includes a more detailed description in which word-initial nasalization is claimed to be optional before front vowels.

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Ignoring certain details, these analyses can be restated in rule form as follows:

(19) a. **Initial Nasalization:**
/w,ɾ/ —> [+nasal] / # __

b. **Final Hardening:**
[+sonorant] —> [-continuant] / syllable-finally

Rule (19a) nasalizes /w/ and /r/ word-initially. (19b) changes /w/ and /r/ to stops syllable-finally.

Harris and Voegelin do not justify adopting /w/ and /r/ as the underlying phonemes in Hidatsa. Indeed, it is possible that their analysis might have been different had they been aware of the data in (17-18).[6] In view of the new data in (17-18), it seems reasonable to reconsider their analysis, or at least to find additional justification for it.

It is not possible to adopt /p/ and /t/ as the underlying phonemes in Hidatsa, since, as the following examples from Robinett (1955:3) show, there are near minimal pairs between the voiceless stops and the resonants:

(20) a. tá·ri-c 'he crosses'
b. rá·ruwi-c 'he's still going along'

(21) a. xápi-c 'he lies down'
b. hiráwi-c 'he sleeps'

In (20), /t/ contrasts almost minimally with Robinett's phoneme /r/. Similarly, /p/ contrasts intervocalically with /w/ in (21).

It is possible, however, that [m,w,p] and [n,ɾ,t] are underlyingly /m/ and /n/. If this were the case, the rules for allophony in Hidatsa would be as follows:

(22) a. **Hidatsa Lenition:**
[+nasal] —> [+continuant, -nasal] / V__V

b. **Final Hardening:** (applies after (22a))
[+sonorant] —> [-continuant] / syllable-finally

Rule (22a) lenites and oralizes /m/ and /n/ intervocalically. Rule (22b) (repeated from (19b)) changes [w] and [r] to [p] and [t] syllable-finally. I assume that a rule of final vowel deletion (deletion of Robinett's 'weak vowels') will apply between (22a) and (22b) to create syllable-final resonants.

It would seem that there are crosslinguistic reasons for preferring the rules in (22) to those in (19). Specifically, there is precedence in other languages for /m/ weakening to [w] intervocalically, as in the nearby Numic (Uto-Aztecan) languages. I know of no uncontroversial examples of /w/ nasalizing word-initially in a language. Similarly, oralization of nasals in an oral context is a phonetically motivated rule of assimilation. I can see no phonetic motivation for /w/ and /r/ nasalizing word-initially. Given a choice, then, and in the absence of arguments to the contrary, one would tend to favor the more natural directionality implied by (22a).

These factors would suggest that /m/ and /n/ are basic, and [w,p] and [r,t] derived. While it is probably not impossible that such a system could be reanalyzed so that /w/ and /r/ were the underlying phonemes, I know of no evidence to support such a position. In the absence of such evidence, I will continue to assume what I take to be the more natural rule set in (22). On this analysis, Hidatsa resonants will be analyzed in the same way the Crow resonants were analyzed in section 2. Some example derivations appear in (23-24):

(23)	/miní/	'water'
	/mirí/	(Hidatsa Lenition (22a))
	mirí	'water'
(24)	/kanámi/	'remember'
	/karáwi/	(Hidatsa Lenition (22a))
	/karáw/	(Vowel Deletion)
	/karáp/	(Final Hardening (22b))
	karáp	'remember!'

I will discuss the implications of these findings in the next section.

4. Proto-Missouri River. Previous published work on Proto-Siouan has assumed that the resonants in Proto-Missouri River were /w/ and /r/. Thus, Wolff (1950) writes that "Proto-Siouan *m became /w/ in Crow-Hidatsa", that "Crow *n was retained in morpheme initial, but became /r/ medially", and that "in Hidatsa all *n reflexes became /r/" (p. 119).[7] Matthews (1970) avoids explicitly reconstructing the Proto-Missouri River resonants. Instead, he states that "P[roto-]Si[ouan] n, r, and ɾ fell together in C[row-]H[idatsa] and appear as a single systematic phoneme as n in word-initial position, and as ɾ —a dental flap—intervocalically" (p. 100). In his etymologies, however, he uses /w/ and /r/ for both Crow and Hidatsa, so that 'water' is written *wirí* in Hidatsa and *wiré* in Crow. Rood (1979) follows earlier sources in suggesting that the change of *m and *n into /w/ and /r/ in Crow-Hidatsa is diagnostic of the Missouri River branch of Siouan.

I have argued that /m/ and /n/ better represent the resonant consonant phonemes in Crow, and I have suggested that /m/ and /n/ in Hidatsa would make the rules of allophony more natural in that language. Let us now consider the implications of these findings for Proto-Missouri River. The four cognates in (25) are a sample from those in Matthews (1980). I have listed the Crow forms with sentence final /-k/ in order not to obscure the underlying stem vowel:

(25) EAT (tr.). *Crow* duuší-k; *Hidatsa* núuti.
EAT (intr.). *Crow* baa-luuší-k; *Hidatsa* maa-rúuti.
MOUNTAIN. *Crow* awa-xaawí-k; *Hidatsa* awa-xáawi.
WATER. *Crow* bilí-k; *Hidatsa* mirí.

On the analysis presented in sections 2 and 3, the forms in (25) would be written phonemically as follows:

(26) EAT (tr.). *Crow* /nuuší-k/; *Hidatsa* /núuti/.
EAT (intr.). *Crow* /maa-nuuší-k/; *Hidatsa* /maa-núuti/.
MOUNTAIN. *Crow* /ama-xaamí-k/; *Hidatsa* /ama-xáami/.
WATER. *Crow* /miní-k/; *Hidatsa* /miní/.

Using the comparative method, we arrive at the following Proto-Missouri forms, ignoring accent:

(27) EAT (tr.). */nuuti/.
EAT (intr.). */maa-nuuti/.
MOUNTAIN. */ama-xaami/.
WATER. */mini/.

The Proto-Missouri River phonemic forms can be reconstructed in this case by comparing the phonemic forms in each of the daughter languages. I am assuming the simplest type of reconstruction here, in which no reanalysis has occurred.

The close similarity between Crow and Hidatsa makes it possible to go beyond reconstruction of the phonemic representations in (27) and to reconstruct aspects of their pronunciation. Initial Oralization in Crow seems likely to be an innovation in that language, especially when we consider that the rule applies only optionally in Crow. The pronunciation of [l] instead of [r] also appears to be a very recent development in Crow. Both Crow and Hidatsa agree, however, in oralizing and leniting nasals intervocalically, suggesting that the following rule was present in Proto-Missouri River:

(28) [+nasal] —> [+continuant,-nasal] / V__V

The rule in (28) changes */m/ and */n/ to *[w] and *[r], respectively, in intervocalic position. By (28), the Proto-Missouri River nasals in (27) would have been pronounced as in modern Hidatsa. (In general, Hidatsa is remarkably conservative in comparison to Crow.)

The pronunciation of the nasal phonemes in consonant clusters is less clear. The only clusters involving at least one nasal I have been able to find in Hidatsa are of the shape /m+h/ and /n+h/, realized as [ph] and [th], respectively. I have been unable to find clusters of this type in Crow in most sources on Crow (but see note 3). Conversely, where Crow has clusters /mm/, /mn/, /nm/, /nn/, /Cm/, and /Cn/, I have been unable to locate counterparts in Hidatsa, though the Hidatsa data available to me is limited. I suspect that Proto-Missouri River did not allow nasals to appear in consonant clusters, though Hidatsa and Crow have each relaxed this constraint in different directions.

Using the comparative method, I have reconstructed phonemes */m/ and */n/ in Proto-Missouri River, with oral allophones in intervocalic position. This result is somewhat surprising given the currently accepted reconstruction of Proto-Siouan phonemes, in which the phonemic inventory includes nasal vowels, */w/, and */r/, but no nasal consonants. An anonymous reviewer notes that such a reconstruction is apparently needed on the grounds that

nasality in Proto-Siouan resonants is predictable from the distribution of nasal vowels, while the distribution of nasal vowels is not predictable from the distribution of the resonants. Note, however, that these distributional facts would only constitute an argument for nasal vowel phonemes in Proto-Siouan, and do not, strictly speaking, provide evidence for or against */m/ and */n/ in Proto-Siouan. If Proto-Siouan had a rule oralizing resonants between oral vowels, for example, then */m/ and */n/ would do just as well as */w/ and */r/: Neither oralization of resonants in oral contexts nor nasalization of resonants in nasal contexts would be particularly surprising as phonological rules. However, if */m/ and */n/ are reconstructed for Proto-Siouan, then the only development needed to describe Proto-Missouri River is for the nasal vowels to merge with the oral vowels.

A full investigation of Proto-Siouan resonants would go beyond the narrow confines set for this paper. In the sections above, I presented evidence that /m/ and /n/ are phonemes in Crow, and that the same analysis suggested for Crow can be extended to Hidatsa with little modification. Using the comparative method, I reconstructed */m/ and */n/ for Proto-Missouri River. Further research will be needed to explore the deeper implications of this analysis for Hidatsa phonology (where my data was limited), and to study the implications of these findings for the reconstruction of Proto-Siouan.

NOTES

1. My work on Crow began in 1987 in a field methods course taught by Pamela Munro. I would like to thank April Dillon Storey of Pryor, Montana and John Stewart of Wyola, Montana for help with Crow, the Linguistics Department at UCLA for providing consultant funds, and Pamela Munro, Bruce Hayes, and an anonymous reviewer for important suggestions. I have adopted the general framework of Chomsky and Halle (1968) for this paper.

2. Crow forms that are italicized or that appear in cognate sets in this paper are written in the practical orthography used in Matthews (1981) and Medicine Horse (1987), except that I write *š* and *č* here for the alveopalatal fricative and affricate. The practical orthography is largely phonemic, except that the allophones of [b,m,w] and [d,n,l] are written phonetically. The practical orthography is thus sufficiently detailed to record the phonetic phenomena discussed in this work. Crow has the following obstruent phonemes: /p,t,č,k,s,š,x,h/. The vowels are /a,i,e,o,u/, with phonemic length.

3. Neither April Storey nor John Stewart pronounce /h/ before nasals, so that the /h/ in a word like *ba-llahi-k* 'I breathed' is lost in the future: *ba-lla-m-ima*. For Gordon's speakers, /h/ was apparently pronounced as a voiceless nasal when before another nasal. I have elicited nasals occurring before /h/ in a few instances from John Stewart: *dlin-huu-k* 'he came walking' (<*dlili-* 'walk'+ *húu-* 'come'); *iškún-hule* 'finger bone' (<*iškuld-* 'finger'+ *hull-* 'bone'), *ičalatdan-hule* 'toe bone' (<*ičalatdawi-* 'toe'+ *hull-* 'bone'). Since other authors do not describe these combinations, and since they were elicited rather than volunteered, I have not included a discussion of these forms in the text, though they support a wider distribution of nasals.

4. Crow has a general rule deleting a short vowel morpheme-finally. This rule is blocked where applying it would create impermissible clusters (for example, when it would create the impossible sequence resonant-obstruent).

5. Crow has a rule assimilating /n/ to the place of a following consonant.

6. Robinett (1955a:1) states: "My alignment of allophones into phonemes agrees with that of Voegelin and Harris. However, alternative solutions are possible for certain parts of the phonemic system." From the context of this statement, it appears she is referring to the phonemic treatment of the fortis series, though it is possible she had the resonants in mind as well.

7. Wolff was unable to establish whether Crow had separate /w/ and /m/ phonemes because his Crow data is based on Lowie (1941). Lowie only haphazardly records geminates.

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